

REMARKS

Claims 1-23 are pending in the application. In the Office Action mailed on June 12, 2007, the Examiner took the following action: (1) rejected claims 17 and 18 under 35 U.S.C. §112, first paragraph, as failing to comply with the enablement requirement; (2) rejected claims 17 and 18 under 35 U.S.C. §112, second paragraph; (3) rejected claims 1-5, 7-12, 15-22 under U.S.C. §102(b) as being anticipated by Bour (EP 977,279); (4) rejected claims 6 and 13-14 under 25 U.S.C. §103(a) as being unpatentable over Bour in view of Schetzina (U.S. 6,046,464); and (5) rejected claim 23 under 35 U.S.C. §103(a) as being unpatentable over Takayama (U.S. 6,521,917) in view of Bour. Applicants hereby amend claims 1, 6, 8, 17-19, and 22-23. Claim 3 is canceled. Applicants respectfully request reconsideration of the application in view of the foregoing amendments and the following remarks.

I. Rejections under 35 U.S.C. §112

Claims 17-18 are rejected under 35 U.S.C. §112, first and second paragraph. In order to comply with the enablement requirement, the transparency of the substrate 22 and the transparent conductive coating (TCC) 24 with respect to the type of electromagnetic radiation has been more thoroughly described. Additionally, claims 17-18 have also been amended to incorporate enabling details to conform to the written description requirement. No new matter has been added. Claims 17-18 have not been amended as set forth above for reasons related to patentability over the prior art or to narrow the Claims.

II. Rejections under 35 U.S.C. §102(b)

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Claims 1-5, 7-12, and 15-22 under U.S.C. §102(b) are rejected as being anticipated by Bour (EP 977,279). Applicants respectfully traverse the rejection, and submit the claims are allowable over the cited reference to Bour for the reasons explained in detail below.

Bour (EP 977,276)

Bour discloses a method for forming group III-V nitride films on a substrate. (Column 2, Lines 17-18). The substrate is usable to form short-wavelength visible light-emitting optoelectronic devices, including light-emitting diodes and diode lasers. (Column 2, Lines 18-20). Specifically, Bour provides a method for the growth of light-emitting device heterostructures over a thick InGaN layer that provides a suitable bandgap for blue, green, or red light emissions. (Column 2, Lines 21-24).

Claims 1-5, 7-12, and 15-18

Claims 2, 4-5 and 7-12 and 15-18 depend from claim 1. Claim 3 is canceled. Claim 1, as amended, recites:

1. A multi-junction solar cell assembly comprising:
a transparent substrate;
a transparent conductive coating formed on the transparent substrate,
said transparent conductive coating comprising gallium nitride;
a plurality of gallium indium nitride junction layers formed
successively on the transparent conductive coating;
an indium nitride junction layer formed on the plurality of gallium
indium nitride junction layers; and
a metallization layer formed on the indium nitride junction layer.

Applicants respectfully assert that claim 1 is patentable over Bour. In particular, Bour does not teach or suggest, “an *indium nitride junction layer* formed on the plurality of gallium indium nitride junction layers,” as recited in claim 1. (emphasis added).

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In contrast, Bour disclose a second group III-V nitride layer 440 that is formed over an InGaN activer layer 435. (Column 8, Lines 35-39; Figure 5). However, Bour specifically states that, "the first, second and third group III-V nitride layers 430, 440 and 450 each may be formed of GaN, AlGa_N, InGa_N and/or AlInGa_N." (Column 8, Lines 32-34). Bour does not teach or suggest that the second group III-V nitride layer 440 is an "indium nitride" layer, or InN, as disclosed in claim 1. Accordingly, claim 1 is allowable over Bour.

Furthermore, because claims 2, 4-5, 7-12 and 15-18 depend from claim 1, they are also allowable over the cited reference to Bour for at least the same reasons that make claim 1 allowable, as well as for additional limitations recited in those claims.

Specifically, claim 8 is further allowable over Bour. Claim 8, as amended, recites:

8. A multi-junction solar cell assembly in accordance with claim 1, further comprising *at least three* gallium indium nitride junction layers, wherein each successive layer of the plurality of gallium indium nitride junction layers has a *gallium content less than the immediately preceding layer* of the plurality of gallium indium nitride junction layers and an *indium content greater than the immediately preceding layer* of the plurality of gallium indium nitride junction layers. (emphasis added).

First, Bour does not teach or suggest a multi-junction solar cell, as recited in claim 8, "further comprising *at least three* gallium indium nitride junction layers, wherein each successive layer of the plurality of gallium indium nitride junction layers has a an *indium content greater than the immediately preceding layer* of the plurality of gallium indium nitride junction layers." Instead, Bour discloses that the indium content of a second InGa_N film may be increased to 50% by growing the film on a first InGa_N layer containing 30% indium, rather than on Ga_N. (Column 10, Lines 7-13). However, Bour does not disclose the growth of any additional InGa_N films with increased indium content on the InGa_N film with 50% indium. In other words, Bour does not teach or suggest an assembly comprising *at least three* InGa_N layers of increasing indium content. (emphasis added). Accordingly, claim 8 is further allowable.

Claims 19-21

Claims 20-21 depend from claim 19. Claim 19, as amended, recites:

19. A method of forming a multi-junction solar cell assembly comprising the steps of:
forming a transparent conductive coating including gallium nitride on a substrate;
forming a plurality of gallium indium nitride junction layers on the transparent conductive coating; and
forming a metallization layer on the plurality of gallium indium nitride junction layers, wherein the metallization layer is selected from a group that includes a layer of aluminum, a layer of chromium, and a layer of titanium.

Applicants respectfully assert that claim 19 is patentable over Bour. In particular, Bour does not teach or suggest, “wherein the metallization layer is selected from a group that includes *a layer of aluminum, a layer of chromium, and a layer of titanium,*” as recited in claim 19. (emphasis added).

In contrast, Bour disclose a second group III-V nitride layer 450 that “facilitates the formation of a minimum-resistance metal electrode.” (Column 8, Lines 28-31). Bour specifically states that, “the first, second and third group III-V nitride layers 430, 440 and 450 each may be formed of GaN, AlGa_N, InGa_N and/or AlInGa_N.” (Column 8, Lines 32-34). Accordingly, claim 19 is allowable over Bour.

Furthermore, because claims 20-21 depend from claim 19, they are also allowable over the cited reference to Bour for at least the same reasons that make claim 1 allowable, as well as for additional limitations recited in those claims.

Specifically, claim 20 is further allowable over Bour. Claim 20, as amended, recites:

20. A method in accordance with claim 19 further comprising forming *an Indium* nitride junction layer on the plurality of gallium indium nitride junction layers between the metallization layer and the plurality of gallium indium nitride junction layers.

Applicants incorporate the argument presented above in response to the rejection of claim 1 under 35 U.S.C. §102(a) by analogy. Accordingly, applicants respectfully submit that Bour does not teach or suggest, “forming *an Indium* nitride junction layer on the plurality of gallium indium nitride junction layers between the metallization layer and the plurality of gallium indium nitride junction layers,” as recited in claim 20.

Claim 22

Claim 22, as amended, recites:

- 22. A solar cell assembly comprising:
 - a transparent substrate;
 - a transparent conductive coating formed on the transparent substrate, said transparent conductive coating comprising gallium nitride;
 - a gallium indium nitride junction layer formed directly on the transparent conductive coating in intimate contact with the transparent conductive coating;
 - an indium nitride junction layer formed on the gallium indium nitride junction layers; and
 - a metallization layer formed on the indium nitride junction layer.

Applicants respectfully assert that claim 22 is patentable over Bour. In particular, applicants incorporate the arguments presented above in response to the rejection of claim 1 under 35 U.S.C. §102(a) by analogy. Accordingly, applicants respectfully submit that Bour does not teach or suggest, “an *indium nitride* junction layer formed on the gallium indium nitride junction layers,” as recited in claim 22. Accordingly, claim 22 is allowable over Bour.

III. Rejections under 35 U.S.C. §103(a)

Claims 6 and 13-14 are rejected under 35 U.S.C. §103(a) as being unpatentable over Bour in view of Schetzina. Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable

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over Takayama in view of Bour. Applicants respectfully traverse these rejections, and submit that the claims are allowable over the references cited for the reasons explained in detail below.

Schetzina (U.S. 6,046,464)

Schetzina discloses an integrated heterostructure of Group III-V nitride compound semiconductors. (Column 5, Lines 59-61). The integrated heterostructure is formed on a multicomponent platform which includes a substrate of monocrystalline silicon carbide and a non-nitride buffer layer of monocrystalline zinc oxide. (Column 6, Lines 14-29).

Takayama (U.S. 6,521,917)

Takayama discloses a group III-nitride quaternary material for use in semiconductor structures. (Column 1, Lines 8-10). The group III-nitride quaternary material is configured to reduce or eliminates phase separation and provides increased emission efficiency. (Column 2, Lines 59-64).

Claim 6

Claim 6 depends from claim 1. Claim 6, as amended recites:

6. A multi-junction solar cell assembly in accordance with claim 1 wherein each successive layer of the plurality of gallium indium nitride junction layers has a thickness greater than a thickness of the immediately preceding layer of the plurality of gallium indium nitride junction layers, each successive layer being directly adjacent the immediately preceding layer.

First, applicants respectfully incorporate argument present above in response to the rejection of claim 1 under 35 U.S.C. §102(b), and reassert that the cited reference to Bour does not disclose the solar assembly recited in claim 1. Moreover, the deficiencies of Bour are not remedied by Schetzina. Instead, Schetzina discloses varying the thickness of semiconductor

materials in a doped multiple quantum well. (Column 7, Lines 35-40). Thus, the cited references to Bour and Schetzina, whether individually or in combination, do not disclose, teach or fairly suggest, “an *indium nitride junction layer* formed on the plurality of gallium indium nitride junction layers,” as recited in claim 1. Furthermore, since claim 6 depends from claim 1, it is at least allowable for the same reasons that make claim 1 allowable over the cited references, as well as for additional limitations recited.

Second, as noted by the Examiner, Bour does not teach or suggest, “each successive layer of the plurality of gallium indium nitride junction layers *has a thickness greater than a thickness of the immediately preceding layer* of the plurality of gallium indium nitride junction layers, each successive layer being directly adjacent the immediately preceding layer,” as recited in claim 1. (emphasis added). Moreover, the deficiencies of Bour are not remedied by Schetzina.

Instead, Schetzina discloses a doped multiple quantum well (MQW) that includes “*alternating layers of the first binary Group III-V nitride compound semiconductor material or an alloy thereof and a second binary Group III-V nitride compound semi-conductor material or an alloy thereof, on the first layer.*” (emphasis added). (Column 7, Lines 30-35).

Further, Schetzina specifically discloses that the “thickness of the layers of the *second binary* Group III-V nitride compound semiconductor material or an alloy thereof in the MQW structure increases from adjacent the first layer to opposite the first layer. In other words, Schetzina discloses that only a portion (the second binary layers) of its MQW structure vary in thickness. (emphasis added). (Column 7, Lines 37-40).

Third, while Schetzina teaches that the ohmic contacts 120a and 120b include “graded” layers 122a and 122b, the “graded” in this instance refers to the concentration of the elements that make up the layers rather than the thickness of the layers. (Column 10, Lines 49-53). This is evident by the fact that Schetzina further discloses that “the continuously graded $\text{Al}_{1-y}\text{Ga}_y\text{N}$ layers 112a and 112b may be linearly *graded* such that the concentration of gallium increases

from $y=x$ at the interface with $Al_{1-x}Ga_xN$ cladding layers 114a and 114b, to $y=1$ at the interfaces with the GaN layers 124a and 124b.” (emphasis added). (Column 10, Lines 66-67, Column 11, Lines 1-3). As a result, Sechtzina discloses the varying of concentration of elements in the layers to improve efficiency, rather than the varying the thickness of the layers to improve efficiency.

Thus, the cited references to Bour and Schetzina, whether individually or in combination, do not disclose, teach or fairly suggest, “each successive layer of the plurality of gallium indium nitride junction layers *has a thickness greater than a thickness of the immediately preceding layer* of the plurality of gallium indium nitride junction layers, *each successive layer being directly adjacent the immediately preceding layer*,” as recited in claim 6.

Claims 13-14

Claims 13-14 depend from claim 1. Applicants respectfully incorporate argument present above in response to the rejection of claim 1 under 35 U.S.C. §102(b), and reassert that the cited reference to Bour does not disclose the solar assembly recited in claim 1. Moreover, the deficiencies of Bour are not remedied by Schetzina. Instead, Schetzina discloses a heterostructure device 200 that includes AlGa_N and GaN layers. (Column 11, Lines 59-62). Thus, the cited references to Bour and Schetzina, whether individually or in combination, do not disclose, teach or fairly suggest, “an *indium nitride junction layer* formed on the plurality of gallium indium nitride junction layers,” as recited in claim 1. Furthermore, since claims 13-14 depend from claim 1, they are least allowable for the same reasons that make claim 1 allowable over the cited references, as well as for additional limitations recited in those claims.

Claim 23

Claim 23, as amended recites:

23. A multi-junction solar cell assembly comprising:

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a substrate having a first side and a second side opposite the first side;
a metallization layer formed on the first side of the substrate;
a collector grid formed on the second side of the substrate;
a plurality of gallium indium nitride junction layers formed successively on the collector grid;
an indium nitride junction layer formed on the plurality of gallium indium nitride junction layers; and
a glass cover on the indium nitride junction layer.

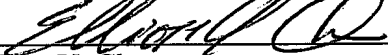
Applicants respectfully submit that Takayama does not teach or suggest, “an *indium nitride junction layer* formed on the plurality of gallium indium nitride junction layers,” as recited in claim 23. (emphasis added). Instead, Takayama discloses a GaN cladding layer that is included directly underneath a Silicon Dioxide layer. (Column 8, Lines 48-50; Figures 7A-7E). Moreover, applicants respectfully incorporate the arguments presented above in response to the rejection of claim 1 under 35 U.S.C. §102(a) by analogy. Accordingly, applicants assert that deficiencies of Takayama are not remedied by Bour. Thus, the cited references to Takayama and Bour, whether individually or in combination, do not disclose, teach or fairly suggest the multi-junction solar cell assembly recited in claim 23.

CONCLUSION

Applicants respectfully submit that pending claims 1-2 and 4-23 are now in condition for allowance. If there are any remaining matters that may be handled by telephone conference, the Examiner is kindly invited to contact the undersigned attorney at the telephone number listed below.

Respectfully Submitted,

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